Technical Reviewers Comments
LRC-XLI-A

"*Lignite Vision 21 Power Plant Project/Gascoyne Project*"
Submitted by: Montana Dakota Utilities
Principal Investigator: Bruce Imsdahl
Request for Phase I: $3,000,000; Phase II: $7,000,000; Project Duration: 2009

1. Objectives

The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Lignite Research Council goals are: 1 – very unclear; 2 – unclear; 3 – clear; 4 – very clear; or 5 – exceptionally clear.

Reviewer M-4 Rating: 4
This project has the potential to consume four million tons annually of North Dakota lignite. The ultimate investment of $740,000,000 in the plant, transmission system, mine, and solid waste-processing facilities will generate a large number of new construction, operating, maintenance, and mining jobs. The majority of the power will be sold to markets outside the state bringing significant income to the state.

Reviewer M-5 Rating: 5
The objectives are very clear in that the ultimate goal of MDU's proposal is to build a 500MW class power plant in southwest North Dakota before the end of this decade and use lignite as the fuel source. This proposal also includes the utilization of coal combustion (ash) products in an adjacent manufacturing facility.

Reviewer M-6 Rating: 5
This project proposal is very complete and clearly meets the goals of the North Dakota Industrial Commission and the Lignite Research Council in the statutory requirements of promoting economic, efficient and clean uses of North Dakota lignite and its products. The proposed location of this site away from the existing generating units and the attendant Class I air quality concerns makes the information obtained from this work desirable to the North Dakota lignite industry. The Phase I and II portions of this project contain the major elements necessary to make a decision to go forward with Phase III implementation activities.

Reviewer M-7 Rating: 4
The overall project will benefit North Dakota, and specifically the Lignite Mining and utility industries. Economic benefits to the state of North Dakota for this project are clear by supplying both the Mining and Utility industry jobs in North Dakota. Economic benefits to the state also include additional revenues from taxation, fostering peripheral industries and revenues from external sources through the sale of electricity. Overall benefits could be a boom for the areas around Gascoyne.

Reviewer M-8 Rating: 4
The objectives statement is weak, but the proposal's discussion clarifies proponents' plans.

2. Achievability

With the approach suggested and time and budget available, the objectives are: 1 – not achievable; 2 – possibly achievable; 3 – likely achievable; 4 – most likely achievable; or 5 – certainly achievable.

Reviewer M-4 Rating: 4

The studies over the five years of Phase I and II at a total cost of $20,000,000 appear to be well planned and appropriately budgeted. It should be clear at the end of that effort as to whether the project is environmentally and economically feasible.

Reviewer M-5 Rating: 3

While the feasibility studies can be accomplished as proposed, there appears to be a number of significant challenges on the achievability of the ultimate goal of building a power plant as proposed by MDU. These include 1) air quality issues, 2) the availability of enough water in the immediate area to meet the needs of a large power plant, 3) transmission issues, and 4) a defined market for all of the electricity that would be generated.

Reviewer M-6 Rating: 5

The proposal is certainly achievable as presented as the time lines appear to be quite conservative and the budgets generous. The project is presented in a very organized and logical manner and all major topics addressed. The use of the proposer's staff to manage the various aspects of the project should insure a coordinated result.

Reviewer M-7 Rating: 4

There is a high probability the project, as defined, can be accomplished within the timetable and budget as described. But the project is aggressive, and costs must be contained to be within budget. Montana Dakota Utilities has the skills to accomplish the project.

Concerns

Phase I Costs defined on page 23 of the proposal appear to be low for a Greenfield site. However, because this is not totally a Greenfield site, much of the planning might already be accomplished previously using MDU personnel.

Phase II Very reasonable timetable and costs. Some concerns include definition of plant emissions, and utilization of waste products. No mention has been made of products from scrubbing flue gases for the production of gypsum or raw sulfur. In addition to Ash I assume these products will be addressed in Phase I and Phase II of the project.

Phase III Costs for building a Greenfield power plant and restarting the Gascoyne mine are low and do not appear to have been adjusted for inflation.

Since the proposal did not define the station type, the author must assume it is a PC fired boiler system, similar to other units around the US. However, with local sensitivities including

emissions, waste disposal, water utilization, and availability of coal the cost containment may be extremely aggressive.

Again since the utility will utilize in-house expertise, and facilities, and possibly duplicate an existing facility, the author will assume the costs can be contained.

Reviewer M-8 Rating: 2
The proposal presents tasks arranged in three phases.

Phase I, task 2, seems to place air quality modeling as a turnkey decision tool by using modeling results to identify plant designs that could be air quality permitted. But, the proposal also mentions that modeling analysis is not a part of the proposal. The proponent's intended strategy should be clarified.

Phase I, task 6, proposes that the combustion block will be state of the art. Does the proponent intend to include and consider such technologies as circulating fluidized bed and integrated gasification combined cycle?

Phase I, task 6, indicates combustion byproduct utilization and that the physical, chemical, mineralogical, and hydration characteristics of lignite combustion produced at the facility will be analyzed; task timelines are shown in figure 2. The proposal is not clear as to the degree of certainty of commercialization of utilized combustion byproducts, given that the actual characterization of byproducts cannot be verified until the combustion block and emission control systems are in operation.

3. <u>Methodology</u>

The quality of the methodology displayed in the proposal is: 1 – well below average; 2 – below average; 3 – average; 4 – above average; or 5 – well above average.

Reviewer M-4 Rating: 4
The detailed discussion of the plans for each Task of the project indicates a very deep understanding of the economic and environmental issues involved in a feasibility study of this type.

Reviewer M-5 Rating: 2
The overall methods are satisfactory, but I believe some of the tasks as proposed in the application should not be part of the Phase I feasibility study. While studying air quality issues, water availability, and a general environmental assessment of the proposed plant site are appropriate for Phase I, preparing a facility siting permit application for submittal to the Public Service Commission and an application for a Health Department permit for disposing coal combustion wastes should not be considered until Phase II of the project. In addition, Phase I includes a mine feasibility study that includes surface and coal ownership reviews, right of entry and lease acquisitions, a test hole drilling program, and coal quality analyses. The proposed budget for this task is quite high and such work would provide little or no value if a determination is made following the other Phase I studies that the project is not feasible. In

addition, the applicant should already have considerable knowledge of the lignite characteristics in the Gascoyne area since one of its subsidiaries owned and operated the Gascoyne Mine. I recommend that the proposed mine feasibility study also be delayed until Phase II of the project.

Reviewer M-6 Rating: 4
This proposal has a thoroughly thought out methodology that has identified most all of the major issues and carefully addresses how they will be investigated and reported.

Reviewer M-7 Rating: 5
The utility appears to have a team capable of developing and implementing this project using existing and "state of the art" technologies in concert with existing regulations. Since MDU is familiar with power production and distribution they should have no problems defining the project in Phase I and Phase II, and implementing the project in Phase III.

Reviewer M-8 Rating: 2
The proposal does describe principal issues, but it does not describe the methods of study in sufficient detail so as to convey an ability to complete the tasks.

4. <u>Contribution</u>

The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Lignite Research Council goals will likely be: 1 – extremely small; 2 – small; 3 – significant; 4 – very significant; or 5 – extremely significant.

Reviewer M-4 Rating: 2
This project will provide some new technical information on the reuse of solid combustion waste products. The rest of the project appears to involve the application of conventional design processes to the power plant and transmission design issues.

Reviewer M-5 Rating: 3
The construction of a new lignite fueled power plant using state of the art environmental controls would provide significant contributions to address goals of the Industrial Commission/Lignite Research Council. However, few details are provided on the combustion options that will be considered for the new power plant, including the possible use of clean coal combustion technology.

Reviewer M-6 Rating: 5
Much of the work described in Phase I of this proposal is necessary to identify the potential for a lignite conversion facility that is not significantly impacted by the Class I air quality concerns associated with the existing lignite fired generation in the state. This information should be of great value to the state as it looks to how to develop it's lignite resources in the future.

Reviewer M-7 Rating: 2
There is nothing novel about the project as it appears to utilize existing mining, transport, storage, combustion, emission control, and power transmission technologies.

Coal mining utilizing existing equipment and technologies
Coal Cleaning - None anticipated
Coal Combustion - Utilizing current combustion technologies - assumed Pulverized Coal
Emission Control systems - Not Defined by the project
Balance of Plant equipment - Existing boiler - steam turbine system
Transmission Systems - Current transmission technology

By utilizing well-defined systems MDU can minimize power production and economic risks to the project. However by utilizing this path they eliminate the increased " scientific and/or technical contribution of the proposed work". In addition they may reduce the potential future economic benefits of the project.
The author recommends MDU investigate the use of other technologies, including Integrated Gasification Combined Cycle, under phase I and phase II of the project. Benefits include:

- This high moisture coal has almost the correct water, carbon, hydrogen balance for gasification without extra moisture.
- Increased cycle efficiency from mid 30 percent to mid 40 percent, which will extend the mine life by reducing coal consumption about 30 percent.
- Increased coal recovery by utilizing higher ash - off specification coal.
- Water consumption by the project will be reduced. The project has the potential of being a net water producer.
- Significant reduction in emissions.
- Production of salable byproducts including sulfur, hydrogen, fused ash and others

Reviewer M-8 Rating: 4
No new scientific contribution would be expected; however, if objectives of Phases I and II are successfully completed, the proposed project could clarify the feasibility for a 500 MW base load, lignite fired electric generating station located near Gascoyne.

5. <u>Awareness</u>
The principal investigator's awareness of current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer M-4 Rating: 3
There is very little technical research involved in this project. The principal investigator was involved in the successful application of Fluidized Bed Combustion technology to a boiler at the Heskett Station and has demonstrated his competence in applying new technology. It is unclear in the proposal as to whether FBC technology will be considered for this plant or whether only conventional combustion technology will be considered.

Reviewer M-5 Rating: 3
While only a few research publications are referenced in the proposal, it seems the applicant would be aware of the latest research that would apply to this project based on its history of

owning and operating lignite fired power plants. However, no references were made to clean coal combustion technology that may be considered for the proposed power plant.

Reviewer M-6 Rating: 4
The Principal Investigator does make several specific references to appropriate supporting work that has been completed in the past 20 years concerning topics applying to this proposal. The proposal also makes general references to other reports and publications that would indicate an awareness of other work that relate to this type of activity.

Reviewer M-7 Rating: 2
The investigators appeared to limit the project to include existing mining, combustion, emission control, and power transmission technologies with which they are familiar. The development team appears to be well qualified to accomplish the goals using these technologies, and minimizing risk to the project.

Reviewer M-8 Rating: 3
See also scoring item 6 below.

6. <u>Background</u>

The background of the investigator(s) as related to the proposed work is: 1 – very limited; 2 – limited; 3 – adequate; 4 – better than average; or 5 – exceptional.

Reviewer M-4 Rating: 4
The team that has been proposed for this project is well qualified to manage the numerous and varied tasks that make up the totality of this project. They are well experienced in the required areas. The use of consultants has been proposed in areas where sufficient expertise is lacking.

Reviewer M-5 Rating: 4
People involved with the project have considerable experience with lignite-fired power plants and with the transmission, environmental and mining aspects of the project.

Reviewer M-6 Rating: 4
The background of the team of investigators identified in this proposal are well rounded included long term employees as well as those who have had varied backgrounds in the energy business and all seem to be capable in their area of expertise.

Reviewer M-7 Rating: 4
The team defined in the proposal has an extensive background in mining, power production, and power transmission systems. They appear to be very capable of defining the project, engineering the systems, building the plants, and operating the systems.

Reviewer M-8 Rating: 3
The proposal does not provide adequate detail so as to determine whether the investigator's background is better than average or exceptional.

7. Project Management

The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the investigators and subcontractors, if any, is: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – very good; or 5 – exceptionally good.

Reviewer M-4 Rating: 4
The project management plan is well conceived and thorough. All aspects of the project have been considered and plans developed to acquire the needed information.

Reviewer M-5 Rating: 3
The management plan appears adequate; however, the financial plan has limited details.

Reviewer M-6 Rating: 4
The project management plan is well defined and includes the topics and activities necessary for a well run project and if implemented as described should result in a successful project.

Reviewer M-7 Rating: 4
From a proposal prospective, the project is well defined in chronological order. The author feels these team members have done similar projects, both within and outside MDU. The milestones are well defined, but appear to be very aggressive since many state and federal regulators must approve the project before the first yard of concrete is laid. The budget appears to be within current norms, however, environmental, plant design, and mining concerns may increase the scope of the project. After Phases I and II are complete the team should have a better idea of the scope and costs for this project.

Reviewer M-8 Rating: 3
Given the lack of details in the proposal, it is unclear whether the task schedules, task funding are adequate or excessive; however, both seem within the range anticipated for the scale of the project.

8. Equipment Purchase

The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)

Reviewer M-4 Rating: 5
No equipment is to be purchased.

Reviewer M-5 Rating: 5
It appears no equipment would be purchased for this proposal.

Reviewer M-6 Rating: 5
No proposed equipment purchase.

Reviewer M-7 Rating: 5
As indicated above, this project is designed to increase mining jobs in North Dakota, and supply needed power to the state, and surrounding localities. This should improve the economic opportunities in the area and alleviate the decreasing concerns over the availability of electrical power in US.

Reviewer M-8 Rating: 5
No equipment purchases are listed for phases 1 and 2.

9. Facilities

The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.

Reviewer M-4 Rating: 3
No facilities and equipment are required for this project. It is all essentially modeling, preliminary design, or analysis of mine samples by conventional means.

Reviewer M-5 Rating: 5
Since this is not a research project, no special equipment or facilities are needed. Therefore, a rating of 5 was given.

Reviewer M-6 Rating: 5
No facilities or equipment required.

Reviewer M-7 Rating: 3
Systems proposed by this project are adequate to meet the mining, power production, and electrical generation needs for the project. The author would like MDU to evaluate the use of other systems under phases I and II of the project. This may increase project risks but could reap financial and local economic rewards in the future.

Reviewer M-8 Rating: 5
On the bases of instruction for question 8.

10. Budget

The proposed budget "value"[1] relative to the outlined work and the financial commitment from other sources is of: 1 – very low value; 2 – low value; 3 – average value; 4 – high value; or 5 – very high value. (See below)

[1] "Value" – The value of the projected work and technical outcome for the budgeted amount of the project, based on your estimate of what the work might cost in research settings with which you are familiar.

Financial commitment from other sources – A minimum of 50% of the total project must come from other than Industrial Commission sources to meet the program guidelines. Support less than 50% from Industrial Commission sources should be evaluated as favorable to the application.

Reviewer M-4 Rating: 5
The $10,400,000 cost sharing proposed represents slightly more than 50% of the total funding of $20,000,000 proposed for Phases I and II. It is a major contribution for a project that can have a major impact on the economy of the State of North Dakota.

Reviewer M-5 Rating: 3
The funding to be provided by applicant for the first two phases of the project is only slightly over 50%. However, the applicant has stated it will conduct a preliminary investigation of impacts that the proposed power plant will have on Class I air quality areas. This investigation is not part of the grant application and no estimated costs or details were provided for it. Although an average value rating was given for the two phases proposed for funding, the value would be very high if Industrial Commission funding for the project results in the construction of a new power plant.

Reviewer M-6 Rating: 5
The proposed project has a very high value to the state in determining the future of the lignite industry in North Dakota. The investigation into the potential of having a conversion facility outside the area of the existing lignite facilities that are impacted by the Class I air quality concerns is very necessary. This appears to be a very qualified proposal to do that in Phase I. It does seem a bit "spendy" but may well be on track with today's costs.

Reviewer M-7 Rating: 4
As expressed above the project appears to be within an "expected budget" for this project. However with many unknowns, including plant site, emission control, product utilization, water utilization, and others the project may be under funded. The investigators will determine all costs for the project under phases I and II. After this is complete MDU will have a better idea of overall costs and externalities for constructing and operating the plant.

Reviewer M-8 Rating: 4
However, tables 2 and 3 in combination with figure 2 and described imply that the budget value is more than adequate.

Overall Comments and Recommendations:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer M-4 Recommendation: Fund
The objectives of this project stated by Montana Dakota Utilities (MDU) are to "successfully demonstrate the feasibility of, permit, and thus construct a new, environmentally clean, lignite fired, 500 MW base loaded electric generating station in the Gascoyne, North Dakota area utilizing a pre-existing lignite mine". The feasibility and permitting activities included in Phases I

and II of the project are estimated to cost $20,000,000. The North Dakota Industrial Commission has been asked by this application to provide $10,000,000 to cofund Phases I and II. These funds will be used to support studies of the feasibility of the plant through analysis of the market for energy and capacity, transmission siting and permitting, power block siting and environmental analysis, and initial electric plant design providing for utilization of the combustion products. Phase III of the project, to build the generating plant, transmission lines, and the North Dakota lignite mine, is estimated to cost $740,000,000. The Commission is not being asked to participate in funding for Phase III.

MDU proposed that "the power block be built using combustion technologies that have been proven through years of use" and "the environmental components be state-of-the-art". "The project proposes to include the utilization of the lignite coal combustion products in a manufacturing facility which is expected to be adjacent to the electric generating station".

"In additional to the lignite mine and power plant, MDU intends to study the feasibility of a primary sector business that can derive economic benefit from being adjacent to a power plant, such as, but not limited to, a greenhouse, meat packing plant, aqua-culture facility, and an agricultural processing facility".

None of the technologies to be used in this plant are new, innovative, or developmental. This project appears to be a conventional evaluation of the business prospects for a new generating plant. Since MDU cannot utilize all of the power generated by this plant, a significant fraction of the plant output must be exported to distant markets. There are significant risks involved in a project for which markets are not assured. There are also a number of environmental issues that must be resolved in this project including sulfur emissions from the plant, utilization of solid waste products, and the amount of water that the plant will consume.

There are substantial economic benefits for the area that is proposed for the plant and for the State of North Dakota as a whole in terms of jobs and business opportunities. Cost sharing by the North Dakota Industrial Commission to investigate the economic potential and feasibility of this project appears to be justified.

Reviewer M-5 Recommendation: Funding May Be Considered

While this project clearly meets the goals and objectives of the Lignite Vision 21 program, it will face several significant challenges. In addition to the air quality and transmission issues that must be addressed for any Lignite Vision 21 project, the availability of sufficient water in the Gascoyne area is another critical issue for building a power plant in this area. I recommend only funding a modified version of Phase I at this time. The first phase of the project should be limited to those aspects that will determine the overall feasibility of building a 500 MW class power plant at this location. The proposed Phase I tasks involving the preparation of permit applications for a power plant site and combustion waste disposal facility as well as the mine feasibility study as proposed should not be funded until the other Phase I tasks are completed. Once other Phase I studies conclude that it is feasible to construct a power plant, these tasks could be added to the Phase II tasks and be considered for funding at that time.

Since Westmoreland Power has also submitted a Lignite Vision 21 application for building a power plant in the same area, the Industrial Commission should not fund studies that may duplicate each other. If certain aspects of one application appear better than the other, the better proposal should be considered for funding. This may result in some of the studies being conducted by MDU, while others would be carried out by Westmoreland. Alternately, is it possible for MDU and Westmoreland to combine their applications in some manner?

Reviewer M-6 Recommendation: Fund
This project definitely meets the goals of the NDIC and LRC program and appears to meet the goals of the Lignite Vision 21 Project. It is a well thought out project and seems to have strong support from the proposing organization. Certainly Phase I should be funded but Phase II funding should obviously be made contingent on positive findings from Phase I work.

Reviewer M-7 Recommendation: Fund
As expressed above this project will benefit North Dakota, and specifically the Lignite Mining and utility industries around Gascoyne. The state will benefit from this project by supplying both the Mining and Utility industry jobs, additional revenues from taxation, fostering peripheral industries and revenues from external sources through the sale of electricity.

The power plant and mining project isn't novel, utilizing existing mining, transport, storage, combustion, emission control, and power transmission technologies. Conventional coal mining, no coal cleaning, utilizing current combustion technologies, and standard power plant equipment will minimize project risk. However this path eliminates the increased " scientific and/or technical contribution of the proposed work". In addition they may reduce the potential future economic benefits of the project.

The only project concern is the regulatory uncertainty associated with permitting the existing mine, and associated power plant. This could take far longer time than allotted in the project, forcing additional environmental controls and expanding the project timetable. This would increase the overall cost of the project.

The investigators made mention of utilizing the ash waste products from the power plant. No mention was made of products from the scrubbing system, and possibly NOX control systems. These systems increase the cost of power production, and disposal of by-products. During phases I and II investigators should evaluate using all by-products from the power plant system.

The author recommends investigating the use of higher efficiency technologies, lower emission systems in the power plant. These systems would have the benefit of extending mine life, decreasing water consumption and improving salable by-products from the plant.

Reviewer M-8 Recommendation: Funding May Be Considered -- Phase I only

MDU Resource Group’s familiarity with the Gascoyne Mine and the surrounding region should help it facilitate the necessary work for each of proposed tasks, although the task discussions in

the proposal do not convey an achievable outcome so as to proceed with construction of the 500 MW base load plant.